OPERATION OF THE WATER FILTRATION PLANTS AT EVANSTON, ILLINOIS, AND WHITING, INDIANA[1]

By Samuel A. Greeley[2]

The filtration of the public water supplies from Lake Michgan in the vicinity of Chicago along the southwestern shore line is becoming more general. Already filter plants have been put into operation at the following places:

Illinois, Great Lakes, Fort Sheridan and Evanston,

Indiana, Whiting and East Chicago.

In addition, a plant is under construction at Winnetka, Ill., and the installation of filter plants is under active consideration at Waukegan and Highland Park and elsewhere along the shore. From these filter plants, filtered water is also supplied to the villages of Wilmette and Glencoe. All present indications point to the conclusion that within the next few years practically all of the public water supplies from Waukegan to Gary will be supplied with filtered water except possibly Chicago. It is interesting, therefore, to make some brief mention of operating experience at some of these filter plants.

Characteristics of Lake Michigan water. No comments on filter plant operation are complete unless the characteristics of the raw water are stated. In Lake Michigan, as is common elsewhere, changing characteristics prevail. The temperature varies with the season, the turbidity with the weather, and the microscopic organisms irregularly chiefly during the warmer months of the year. However, there are also certain marked variations in the character of the raw water produced by the differing populations along the shore. The principal difference is between the shore line north of Chicago and that south of Chicago. At Waukegan, north of Chicago, we find a present moderate industrial development which is likely to increase but, with this exception the north shore line is principally residential. Within Cook County, most of the sewage

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[2] Consulting Engineer, Pearse, Greeley and Hansen, 39 West Adams Street, Chicago, Ill.

has been diverted from the Lake, with the exception of some storm sewage, so that foreign substances of industrial origin difficult to remove are not found. The filter plant at Evanston is typical of this condition.

Along the shore south of Chicago, on the other hand, we have one of the most intensive industrial developments in the world. An immense volume of industrial sewage is produced, estimated roughly at over 500,000,000 gallons per 24 hours. This discharges into the Lake and into the waterways of the Calumet District. The industries are varied from cement mills to chemical works but are predominantly oil and metal industries. Both of these industries produce considerable volumes of coal tar and petroleum wastes which impart tastes to the water supplies of a most persistent character. Due to the influence of these industrial discharges the character of the lake water along the south shore appears to vary within comparatively short distances of from two to three miles. There are in this district recently completed water filtration plants at Whiting (population 12,000) and East Chicago (population 40,000), Indiana. Along the south shore it may be noted that the lake water is shallower than further north so that higher turbidities are somewhat more prevalent.

In general it may be said of Lake Michigan water that the alkalinity is relatively constant although not always responsive to good coagulation with alum and that the other characteristics such as turbidity, organic matter, bacteria, etc., are changed very rapidly and to a large degree by sudden shifts of the wind. In fact, increases in the organic content of several hundred per cent have been noted within a few hours.

Special local factors. Not only are characteristics of the lake water changing from day to day and season to season but there is also a gradual change resulting from local community developments. Thus it is believed that the load of pollution along the Lake County shore in Illinois will soon be decreased by the construction of sewage treatment works under the direction of the Trustees of the North Shore Sanitary District. The development of local factors along the south shore is not so clear although the load of domestic and industrial sewage pollution will decrease with the final reversal of the Calumet River by the completion of the Calumet-Sag Channel expected during 1921. There is need, however, for a comprehensive study of local factors influencing the public water supplies along the south

shore particularly as regards tastes from industrial sewages. Four factors stand out:

a. The location of sewer outlets.

b. The location of water intakes.

c. The treatment of the sewage (including plant processes).

d. The treatment of the water.

The problem will eventually be solved by the economic adjustment of these factors from the community standpoint. It is probable that the treatment of the industrial sewages of large volume will be a costly project although an easy adjustment of plant processes can sometimes be made. The construction of water purification plants is considerably less costly because the water supplies are small in volume as compared with the sewage, and is called for, in any event, as the first line of defense against bacteriological pollution, turbidity and other objectionable qualities of the raw water.

Operating problems. In addition to the usual routine problems of operation those which have called for special study relate to occasional difficulties of securing adequate coagulation; the shortening of filter runs due to the growth of microscopic organisms in the lake and the removal of tastes coming principally from industrial discharges.

The problem of coagulation is always important in filter plant operation and is particularly so at the filter plants in this vicinity at times of operating trouble resulting from algae growths or industrial pollution. The control of algae growths in the lake appears to be impossible and plant operation must therefore be adjusted to meet the difficulty when it occurs. The principal effect is to shorten the filter runs and occasionally to impart a slight residual taste to the filtered water. The problem of taste removal has already been pointed out as one of major community importance involving a number of controllable factors, not directly connected with filter plant operation.

Filter plant elements. In this brief review of filter plant operation reference is made in particular to the plants at Evanston, Whiting and East Chicago. The principal elements are given in table 1.

The plant at Evanston, as originally designed, had a rated capacity of 12,000,000 gallons daily and was operated near that rate for a number of years prior to the installation of meters. It is now being operated at about half its rated capacity. The original period in the coagulating basins of 1 hour and 40 minutes on rated capacity

was relatively short, but is now increased to about 3½ hours. The plant is of standard design with high rate wash, the wash water coming from a storage tank.

The filter plant at East Chicago with a rated capacity of 8,000,000 gallons daily has been in service for about 4 months and is being operated at slightly above rated capacity (8,600,000 gallons daily). The plant is typical of rapid filter design, with a period in the coagulating basins of 3.75 hours and with high rate wash from an elevated tank.

The plant at Whiting differs from the others by the addition of an aerating basin through which the water passes prior to entering the coagulating basins. The coagulating basins provide 4.23 hours displacement at rated capacity of 4,000,000 gallons daily and the plant is being operated at a slightly lower rate. High rate wash is

TABLE 1

Elements of water filtration plants along Lake Michigan near Chicago

PLANT	INTAKE		PLANT CAPACITY	SETTLING PERIOD	OPERATION WINTER 1920-21	
	Length	Depth			Quantity	Capacity
	feet	*feet*	*m. g. d.*	*hours*	*m. g. d.*	*per cent*
Evanston	5600	30	12.0	1.7	4.8	40.0
Whiting	2400	20	4.0	4.23	3.9	97.5
East Chicago	3000	20	8.0	3.75	10.0	125.0
Winnetka	3000	20	3.0	3.8	*	*

* Under construction.

provided from a wash water pump. The plant includes a high lift pumping station which is electrically operated.

Operating routine. It is particularly interesting in the first place to compare the length of run at the various filter plants. The plant at Whiting has been operated at around 3,800,000 to 3,900,000 gallons daily or just below its rated capacity. With that load on the plant the runs during January were 8 hours with alum at 1.5 grains per gallon and in addition lime at the rate of 0.7 grain per gallon. In February the runs were increased to 9.4 hours and the alum cut down to 1.4 grains per gallon. During March even shorter runs have occurred. At Evanston short runs were also experienced during the first few months of operation but these have gradually increased so that now runs from 20 to 80 hours are common as follows:

MONTH OF OPERATION	LENGTH OF RUN
	hours
First	3.8
Second	5.3
Third	8.3
Fourth	7.3
January, 1921	75.0
February, 1921	75.0

It is only necessary to add the labor schedule at the plants so that you may have it for comparative purposes. At East Chicago there is one superintendent, one chemist and three operators, a total of five. At the Whiting plant, where the plant is combined with a high lift pumping station (the first floor is the high lift pumping station, comprising four electrically driven pumps), there is a superintendent and in addition two men on each shift. At the Evanston plant there is a superintendent and one man on each shift. At Evanston and East Chicago the superintendents also look after the high lift pumps. The short operation of these plants has somewhat limited the available data.

TABLE 2

Operating data for water filtration plants along Lake Michigan near Chicago

	DECEMBER, 1920			JANUARY, 1921			FEBRUARY, 1921			MARCH, 1921			APRIL, 1921		
	Evanston	Whiting	East Chicago	Evanston	Whiting	East Chicago	Evanston	Whiting	East Chicago	Evanston	Whiting	East Chicago	Evanston	Whiting	East Chicago
Average quantity filtered M.G.D.	4.6		10.4	4.5	4.0	10.4	4.8	3.9	8.7	5.2	3.8	8.1	5.8	3.7	7.5
Per cent capacity	38.0		130.0	37.0	100.0	130.0	40.0	98.0	109.0	43.0	95.0	101.0	48.5	94.0	94.0
Average runs, hours	87.2		4.4	74.9	8.0	3.6	77.0	9.4	6.2	32.7	7.3	7.4	20.3	4.8	7.7
Maximum runs, hours	144.0		13.0	144.0	15.0	10.2	144.0	19.2	1.7	47.7	15.0	15.0	59.5	7.2	17.7
Minimum runs, hours	28.3		0.5	14.1	4.0	1.0	28.0	4.1	16.8	12.9	4.2	2.5	7.4	3.1	1.3
Wash water, per cent	1.2		16.7	1.6		11.1	1.3	5.9	7.8	2.5	5.9	5.7	2.6	8.4	5.2
Alum, G.P.G	0.7		0.6	0.7	1.5	1.2	0.7	1.4	2.0	0.7	1.4	1.9	0.7	1.6	2.2
Lime, G.P.G			0		0.7	0		1.0	0		1.1	0		1.2	

DISCUSSION

A MEMBER: Was the aeration effective in removing the odors, or the taste, rather?

MR. GREELEY: That is a question that is rather difficult to answer completely because of the complexity of the odors that we get. There appears to be a difference in the petroleum and the coal-tar tastes. There is a substantial improvement due to aeration. You can smell the taste coming off the aeration basin and the filtered water has what may be called a cistern taste, or a flat taste. When we were operating the testing station, we had to taste the water treated. There was no chemical means for determining the taste and there was a substantial agreement that the taste was removed. At the present time, with winds which apparently restrict the pollution to the petroleum odor there is substantial removal. The removal of water carrying a medicinal taste may be different. It is not possible to tell more until we have gone through different seasons and have a more consecutive tabulation of data under different conditions. A plant of four months age has not yet reached its optimum of operation.

DR. BARTOW: Have any analyses been made to show the difference in the water at Whiting and East Chicago? It might be possible to determine the difference in hydrogen ion concentrations.

MR. GREELEY: There are not nearly enough of those data available yet. We have been taking the matter up with the various industries. We want to get the data over seasons and under wind conditions, so that the factors affecting the problem as a whole can be properly related to each other.